

**AC 2007-1830: TRANSATLANTIC DUAL BACHELOR'S DEGREE PROGRAMS
BETWEEN TWO EUROPEAN AND AN AMERICAN UNIVERSITY**

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Transatlantic Dual Bachelor's Degree Programs in Mechanical Engineering between two European and an American University

Abstract

The ATLANTIS project joins the European Union and the United States of America in an unprecedented endeavor to foster international education on the undergraduate level.

Technische Universität Darmstadt (TUD), Germany, Kungliga Tekniska Högskolan (KTH), Stockholm, Sweden, and Virginia Polytechnic Institute and State University (VT), Blacksburg, VA, will jointly establish Dual Bachelor of Science Programs in Mechanical Engineering between 2007 and 2010.

The objective of the project is to produce highly competent graduates in the field of Mechanical Engineering (BSME) that are uniquely prepared to successfully engage and excel in the new global engineering economy. Another objective is to demonstrate that graduation is possible without delaying graduation to the extent that it delays the start of a consecutive master's program. Thus, the study program will be 4 years for students from Virginia Tech and 3 years and a few months for students from TUD and KTH. The language of instruction will be German for students staying at TUD, English for students staying at Virginia Tech, and Swedish or English for students staying at KTH.

The program consists of two transatlantic dual BSME degree programs: VT-TUD and VT-KTH. The third combination TUD-KTH is basically an intra-European exchange and not considered here. The general model for these two dual degree programs is that (1) the students complete their introductory courses at their home universities; (2) they spend a summer at the third university that they will not receive a degree from; and (3) they spend their final year (senior) at the second university that they are receiving a degree from.

1 Introduction

The engineering profession is becoming increasingly globalized as it moves from domestic operations to global outsourcing (subcontracts), to global offshoring (overseas divisions), and, more recently, to global teaming. It is therefore important that engineering students are exposed

firsthand to differing engineering and cultural traditions so as to better prepare them to participate effectively in global engineering teams. The dual BSME consortium provides the participating students with high-quality, firsthand exposure to differing engineering and cultural traditions. Virginia Tech (VT), the Technische Universität Darmstadt (TUD), and Kungliga Tekniska högskolan (KTH) already provide this optional exposure to its students via bilateral BSME senior year abroad programs (VT, TUD) and the European ERASMUS (ec.europa.eu/education/programmes/llp/erasmus/erasmus_en.html) student network program (TUD, KTH). The new dual BSME degree programs adds to this existing exposure by providing the participating students with:

- Both fully and partially immersed study abroad experiences in two guest countries. This compares to the typical approaches of studying only in English, segregating the study-abroad students from the regular students, and limiting them to a single country abroad.
- A study schedule that does not delay the start of a masters program. This compares to the usual approach of dual degree programs that add a year to the bachelor studies.
- A second accredited BSME degree, which is earned abroad, and whose associated public and professional recognition significantly expands the effective employment and graduate-study opportunities that are available to the students.

In particular, it is expected that these unique, differencing factors will foster and ensure a strong, vibrant, and self-sustaining program that persists once the project has been completed.

2 The structure of the dual degree programs

The dual degree programs utilize and comply with the existing accredited BSME programs of the three participating universities. Hence, no new degrees need to be created or be accredited, and the time to full program deployment can thus be minimized. The program consists of two dual BSME degree programs: VT-TUD and VT-KTH. The general model for these two dual degree programs will be that

1. the students complete their introductory courses at their home universities;
2. they spend a summer at the third university that they will not receive a degree from; and
3. they spend their final (senior) year at the second university that they will be receiving a degree from.

These two dual degree programs are based on the existing bilateral BSME senior year abroad program at VT and TUD. Hence, the first dual degree program being developed is between VT and TUD with a semester at KTH. The second dual degree program being developed is between VT and KTH with a semester at TUD, which, again, is based on the existing bilateral BSME senior year abroad program at VT and TUD, given the strong structural similarity between TUD and KTH and thus VT.

Table 1: VT and TUD dual degree program

Virginia Tech students		TU Darmstadt students	
Freshmen year		void	
Fall semester	no change		
Spring semester	no change		
Summer	nothing scheduled	First year	
Sophomore year		First year	
Fall semester	no change	Winter semester	no change
Spring semester	no change	March	reserve time
July at KTH	Swedish language Information Research Course	Summer semester	no change
		August and September at KTH	Swedish language humanities
Junior year		Second year	
Fall semester	no change	Winter semester	no change
Spring semester	no change	March	reserve time
Summer	intensive German language instruction	Summer semester	no change
Senior year		Third year	
Winter semester (TUD)	VT BSME senior at TUD	Fall semester (VT)	TUD BSME senior year at VT
March	reserve time	Spring semester (VT)	TUD BSME senior year at VT
Summer semester (TUD)	VT BSME senior year at TUD	Summer (VT)	12-24 CP humanities
Graduation in mid August, still in time for (dual) MS programs			

2.1 The VT-TUD Dual BSME Degree Program

Table 1 illustrates the VT-TUD dual BSME degree program.

In both versions, the final year is completed at the other university based on the existing bilateral BSME senior year abroad program. This final year is fully immersed in the regular classes and uses the language of the respective host university. The first stay abroad for the Virginia Tech students takes place in July after the Sophomore year and leads to KTH with an introduction to the Swedish language and culture. An Information Research Course can be taken in English.

TUD students go abroad the first time in August and September after their first year. Besides Swedish language also liberal arts courses can be taken that will be transferred back to VT to satisfy, together with the courses taken during the semester following the senior year at VT, the liberal arts requirements that are part of the VT BSME degree program. These liberal arts requirements will also be satisfied in part by a shortly forthcoming change to the TUD BSME degree program requirements: 6 CP (3 semester credit hours) of non-mechanical engineering

electives will be limited to humanities courses (currently, other engineering courses are also allowed), which thus will also be able to count towards the VT BSME degree requirements. For the VT students, June will consist of an online design course that will be taught jointly by KTH and TUD faculty to these VT students at KTH, to the regular TUD students at TUD, and to the VT and KTH students at TUD (see below). This course might also be expanded to include faculty and students at VT, which would make this a true transatlantic design course, similar to the joint course currently offered at VT, TUD, Howard University [USA], ITESM Monterrey [Mexico], and Shanghai Jiao Tong University [yeChina] at the senior BSME and MSME levels.

While the TUD students are generally more than sufficiently proficient in English for studying at VT, the opposite is not the case for VT students going to TUD. VT students will therefore study German integrated during their first three years at VT, or, as shown in Table 1, complete the same studies during three consecutive six-week semesters between their junior (third) and senior (fourth) years (this latter alternative is under development). This language training will be described further below. In the case of the VT students, there will be only one summer during which the students do not have courses or training scheduled. In the case of the TUD students, there are no open periods other than a few weeks between the semesters. It will therefore not be possible for the students to complete the traditional TUD BSME industry internship. The TUD BSME students do not earn academic credits for this internship, because while it is recognized as a substantial real-life engineering experience, its content cannot be effectively quality assured by the TUD faculty. However, the completion of the TUD BSME degree requirements across universities in three different countries (US, Germany, and Sweden) can also reasonably be recognized as a substantial real-life engineering experience. Hence, the TUD BSME degree regulations will be modified to regard this three-country academic experience as an alternative to the traditional engineering internship. In both versions of the VT-TUD dual BSME degree program, the students will complete their studies and exams in mid-August. This will be sufficiently early to enable the students to continue on with graduate studies (Bologna process, second cycle) in either the US, Germany, or in Sweden. This includes the existing dual MSME degree program between VT and TUD or the future dual MSME degree program at TUD and KTH.

The deployment schedule is currently being revised as the program has been launched with two months delay.

2.2 The VT-KTH Dual BSME Degree Program

Table 2 illustrates the VT-KTH dual BSME degree program. In both versions, the final year will be completed at the other university based on a derivative of the VT-TUD BSME senior year abroad program. The final year will be fully immersed in the regular classes and using the language of the respective host university. In both versions, the VT and KTH students will twice attend a six-week summer semesters at TUD. This will include two five-week sessions (mid-June through mid-July) in which they participate in the TUD Summer School Program (50 % German language offered at four different skill levels, and 50 % German culture). It will also include participation in the joint TUD-KTH design course during the same time period (see above), which will count as technical electives at VT and KTH, and which will be used

Virginia Tech students		KTH students	
Freshmen year		void	
Fall semester	no change		
Spring semester	no change		
Summer	nothing scheduled		
Sophomore year		First year	
Fall semester	no change	Winter semester	no change
Spring semester	no change	March	reserve time
July at TUD	German language and culture Research Course	Summer semester	no change
		July and August at TUD	German language humanities
Junior year		Second year	
Fall semester	no change	Winter semester	no change
Spring semester	no change	March	reserve time
Summer	intensive Swedish language instruction	Summer semester	no change
Senior year		Third year	
Winter semester (KTH)	VT BSME senior at KTH	Fall semester (VT)	KTH BSME senior year at VT
Summer semester (KTH)	VT BSME senior year at KTH	Spring semester (VT)	KTH BSME senior year at VT
		Summer (VT)	12-24 CP humanities
Graduation in mid August, still in time for (dual) MS programs			

Table 2: VT and TUD dual degree program

to offload the regular semesters at VT and KTH so the students can more easily attend other required courses as needed. VT does not offer Swedish language courses. The VT students will therefore need to attend Swedish language courses at TUD or at KTH.

One alternative includes completing an introductory Swedish language course (Swedish 1) in July at KTH following the first year at VT (we will use this alternative for the first cohort to create awareness for KTH at VT and to facilitate an early launch prior to having the dual degree program formally deployed). Another alternative, as shown in Figure 4.3, is for the students to attend this language course online with videoconference supplement from KTH during their second Fall and Spring semesters at VT (Swedish 1 via distance learning has been deployed, and Swedish 2, 3, and 4 are in progress). The English language skills for the KTH students are not anticipated to be an issue, though additional language training is available at VT for the incoming KTH students if needed. The VT students in the VT-KTH dual BSME degree program will graduate about two weeks late, while the KTH students in the same program will graduate about three months late. Hence, in both cases the students will complete their BSME studies well before the start of graduate studies (Bologna process, second cycle) in either the US, Germany, or in Sweden later that year. This includes the existing dual MSME degree

program between VT and TUD or the future dual MSME degree program at TUD and KTH. Given a project start in November 2006, the VT-KTH dual BSME degree program will be fully approved by the end of February 2008, and the first cohorts of VT and KTH dual BSME degree students will therefore be able to attend TUD during Summer 2008, and graduate in August 2010. Because of the delayed launch, the schedule is currently under revision.

3 Accreditation

The dual BSME degree programs comply with and are fully integrated into the existing accredited BSME programs at VT, TUD, and KTH, respectively. Hence, these BSME degrees will be fully recognized to the extent they are already recognized in their respective domestic markets. The VT BSME degree program will be subject to ABET re-accreditation in Fall 2007, and the TUD BSME degree program will be subject to peer-university evaluation and subsequent Zentrale Evaluierungs- und Akkreditierungsagentur (ZEvA) re-accreditation in Fall 2007. The KTH BSME degree program was recently evaluated by the Swedish National Agency for Higher Education (June 2006), and it will be reevaluated in three years. The various dual BSME degree options will therefore be included in these respective re-accreditation processes, as appropriate.

4 Transfer of credits and grades

The ECTS credit system is being used as the basis for transfer of academic credits earned by the students. TUD and KTH measure their courses using ECTS credit points (CP). One VT semester credit hour is equivalent to two CP. For the purposes of transfer credits, the sum of the credits for a group of one or more courses will be rounded down to the closest whole number. Grades will not be transferred, but will be available to the student in the form of an official transcript from the university where the grades originate. Transfer credits will only be awarded for grades of “C” (VT), 3.3 (TUD), and 3.3 (KTH) or better.

5 Diploma Supplements

KTH and TUD both issue a European Diploma Supplement in English for their respective BSME degrees. VT issues a diploma and an official transcript in English for its BSME degree. The VT transcript includes a similar informational addendum as the European Diploma Supplement to facilitate its interpretation. The dual BSME graduates will therefore receive these documents as appropriate. A separate informational document will be developed to further explain the context of the dual BSME degree program.

6 Cooperative mechanisms

The faculties of mechanical engineering at VT and TUD already share a broad portfolio of collaborative activities. These include a bilateral BSME senior year abroad program; a dual MSME

degree program; a joint U.S. National Science Foundation (NSF) Research Experiences for Undergraduate (REU) dual international site for automotive technologies; a DFG Graduiertenkolleg for autonomous vehicles; and a joint, team-taught course of global collaborative engineering design. Hence, ongoing collaborations and faculty exchanges are frequent and on the increase, and the faculty members make regular use of numerous high-end videoconference systems. This is complemented by annual summits by the two university administrations.

The faculties of mechanical engineering at TUD and KTH have long engaged in a strong student exchange program in the context of the ERASMUS student network. Both TUD and KTH support extensive German and Swedish language training for their respective outgoing and incoming students. Building on this success, and their similar philosophies with regards to their BSME and MSME programs, these two faculties are now developing a dual MSME program in the context of the CLUSTER consortium (www.cluster.org). Based on these two deep partnerships and their educational philosophical compatibilities, the dual BSME degree consortium brings together VT, TUD, and KTH towards a new comprehensive partnership that will grow to open many new, exciting opportunities for global education and research throughout the BS, MS, and doctoral levels. For all three partners, internationalization is a cornerstone to their respective strategic plans, the commitment to which is clearly demonstrated by their pioneering and high-quality progress towards global educational collaborations. These collaborative degree programs are considered essential to support a deep and sustained internationalization with a solid base in world-leading engineering research. The dual BSME degree consortium and their programs are being designed to be fully symmetric with equal partners. Each degree will be owned by the awarding institution and will be fully supported by the other two partners.

7 Student selection and admission

In all cases, there will not be any exchanges or special considerations during the student's first year of study. Historically, most students that make it through this first year will have a high probability of graduating. Hence, it is expected that the vast majority of students that may apply will be fully qualified for the dual BSME degree program. The student selection and admission process will proceed as follows:

1. The student applies to and is admitted into the regular BSME degree program at his or her home university. This admission decision is the responsibility of that university.
2. After one year of studies, the student applies to one of the dual BSME degree programs. The home university selects and nominates its students, and identifies which students will be subject to the balanced bilateral exchange (see above) and which will have to be responsible for their own tuition and general fees while abroad. As is custom, it is expected that the home university will be selective in whom it nominates.
3. The host university will consider these nominations and will ultimately decide which students to accept into its BSME degree program.

8 Tuition and fees

This program is managed as a balanced, trilateral exchange program in accordance with the existing agreements between the three universities: That is, the students pay tuition and general fees to their home university while studying abroad. The students do not pay tuition and general fees to their host universities. Special fees (e.g., course material fees associated with a particular course), and the costs of living, housing, and travel, etc. while abroad are the responsibility of the traveling student. The intention and standard is that the number of students in the exchange remains balanced. However, the universities have the option, by mutual agreement, to enter into a temporary imbalance (typically rectified within a five-year window), or admit students that are not counted as part of the balanced bilateral exchange. Students that are not part of the balanced bilateral exchange will be responsible for their own tuition and fees at their host-universities.

9 Consortium structure for student and faculty mobility

High-end video conferencing is widely deployed at the three universities and is currently used for meetings, joint seminars, joint projects, and joint courses. Their deployment and usage will be increased as part of this project to facilitate the creation of a common community and sense of a special partnership across the three universities. These three universities already conduct several one-week faculty exchanges per year, complete with guest course lectures and seminars. This will also be expanded as part of this project. In particular, the faculty exchanges will not only involve the mechanical engineering faculty, but also the language and evaluation faculty to help facilitate the creation of multiple points of contact and to engage and encourage the cross-disciplinary collaborations that will be needed to ensure that this dual BSME degree consortium persists successfully beyond the end of the initial project.

10 Language plan

The language training has been designed in its entirety within the existing infrastructure at the three participating universities. In addition, several alternative language-training options, which are under development, will be explored and offered as appropriate to expand the scheduling flexibility for the participating students. Examples of future options being considered include compressed language training semesters; language training emporiums; and online training material with individual or small-group tutoring via high-end videoconference (which can offer the audio fidelity needed). TUD and KTH have a long tradition of student exchanges and therefore offer a complete portfolio of German and Swedish language training for their incoming and outgoing students. They also both offer English language training for outgoing students. VT offers English language training for incoming students and German language training for outgoing students. Hence, the general model will be that

1. students acquire, at their home institution prior to the final year, the full language skill set needed for the full-immersion BSME final year; and
2. students participate in introductory language training while at their secondary host university where they only spend one semester.

There will be two exceptions:

1. The TUD and KTH students will only be scheduled for English language training if requested or needed; and
2. the preparatory Swedish language training for the VT students is delivered by distance learning to VT.

11 International visitor support structure

All three universities are already heavily internationalized, and they are all strongly committed to further increase their respective internationalization. Hence, all three universities have extensive experiences and well-tuned infrastructures in place to facilitate outgoing and incoming international students, scholars, and faculty members. This includes dedicated staffs to facilitate travel briefing, second language training, housing, visa application and processing, social integration, and student advising and counseling.

12 Evaluation plan

The assessment planned reflects both the goals of the program and good practice, beginning with the alignment of assessment strategies and outcomes. Direct methods will provide opportunities for students to demonstrate their achievements; indirect methods will provide evidence of students' and others' perceptions of students' achievements. Where possible, assessment will be embedded in coursework, and multiple measures will be used to effect confidence in the conclusions drawn. Where qualitative methods are used, processes will be designed and data will be analyzed with care. Rubrics for subjective ratings will be developed with agreed upon performance criteria and carefully articulated standards for judgment, and the reliability of raters will be established as they apply the rubrics. In this plan, assessment serves multiple purposes. For instance, program goals and expected learning outcomes will be communicated repeatedly to students during the first two years, and students will be reminded how these outcomes are connected to the program's international component as they prepare to travel abroad. Assessment will occur at various stages and, where appropriate, students will receive feedback tying assessment results to key program outcomes. This feedback will give students important information regarding their accomplishments and expected further progress in relation to the program's stated goals. Thus, not only will assessment feedback be used to assess and improve the program, but it would also help students pursue their experience in more intentional ways and become more reflective of their involvement in the experience. The following data will be collected in the manner indicated:

1. Actuarial measures will be obtained regularly for program evaluation, including data on enrollment, retention, academic performance, program completion, time to degree, and post-graduation matriculation into international graduate programs or placement in industry leveraging students' international preparation.
2. Upon matriculation, students will complete a pre-program questionnaire to provide data regarding their backgrounds and prior experiences with different cultures and languages. At the end of the program, students will complete a post-program questionnaire to evaluate their own achievements with regard to each of the learning outcomes.
3. The standardized Intercultural Development Inventory (IDI) will also be administered twice – once at the beginning of the program to collect baseline data, and once at the end of the program to collect data on students' appreciation for other cultures and their ability to assimilate successfully.
4. At the end of their year abroad, in the capstone experience, students will demonstrate their cumulative accomplishments with respect to each learning outcome. They will accomplish this via a reflective essay that responds to questions/prompts aligned with the learning outcomes. The assignment will be scored twice – once by the course instructor for the purpose of assigning a course grade, and once by a trained panel looking for evidence of graduation-level outcomes achievement.
5. Longitudinal data will be used to create a more complete picture of student growth in relation to student learning and program outcomes, given the developmental nature of most of these outcomes.

Survey data will be collected from alumni, any international graduate program faculty, and any employers. The various surveys will capture multiple perspectives of our graduates' achievements. With respect to the value-added goal of the program, the assessment process will include a comparison of data collected on the following student cohorts: participants of the dual BSME degree program, participants in the bilateral BSME senior year abroad program (VT, TUD) and the ERASMUS student network program (TUD, KTH), and participants in the regular BSME programs without international study or work experience. This design will address the assumption that in order to arrive at an understanding of other cultures, one needs to come into direct contact with them, such as what the program provides.

13 Acknowledgements

This publication was developed under a grant from the Funds for the Improvement of Post-secondary Education (FIPSE grant P116J06-0015) and from the European Commission (2006-4556/001 CPT CPTUSA).

The opinions expressed here do not necessarily represent the policy of or the endorsement by the US Department of Education or the European Commission.

FIPSE in the US Department of Education has awarded a \$ 672,600 EU-U.S. Atlantis grant to the Department of Mechanical Engineering at Virginia Tech (Federal funds cover 100 % of

project costs). The European Commission has awarded a € 624,000 EU-U.S. Atlantis grant to the Department of Mechanical Engineering at Technische Universität Darmstadt, Germany, and to the School of Industrial Engineering and Management at Kungliga Tekniska högskolan, Stockholm, Sweden.